


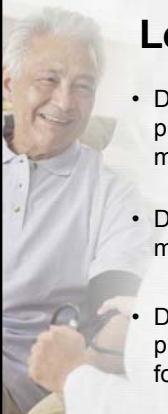
Getting Off the Blood Pressure Roller Coaster
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The Ups and Downs of Blood Pressure Monitoring

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Northwest Pharmacy Convention
May 2013



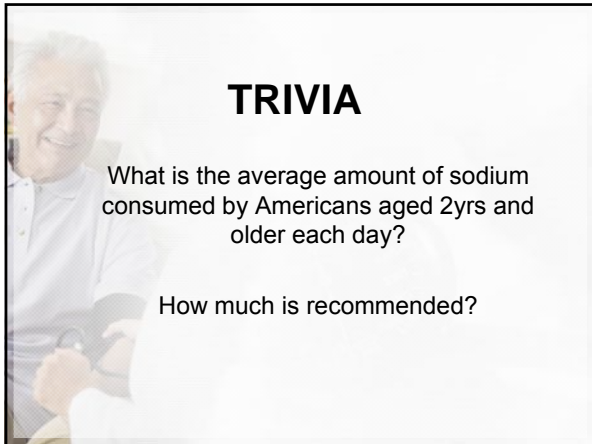
Disclosure

- Katherine Hale is the Principle Investigator for a project funded by the Montana Cardiovascular Health Program titled: *A Hypertension Self-Management Education Service Provided by Community Pharmacists.*
- “This project is funded (in part or in whole) under a contract with the Montana Department of Public Health and Human Services. The statements herein do not necessarily reflect the opinion of the Department.”



Learning Objectives

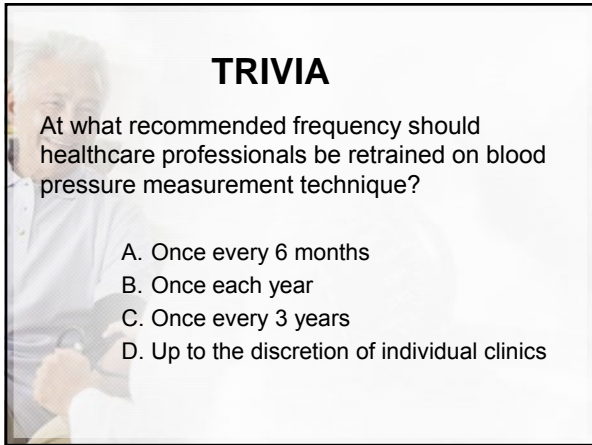
- Discuss the importance of blood pressuring monitoring on the management of blood pressure.
- Describe different methods for monitoring blood pressure.
- Demonstrate the proper use of a blood pressure cuff for home monitoring and for use by healthcare providers.



TRIVIA

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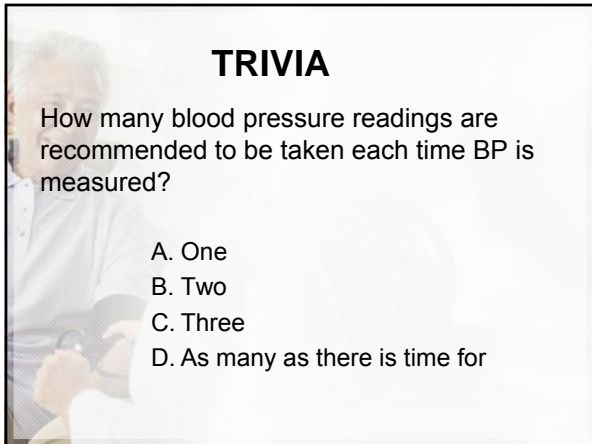
How much is recommended?



TRIVIA

At what recommended frequency should healthcare professionals be retrained on blood pressure measurement technique?

- A. Once every 6 months
- B. Once each year
- C. Once every 3 years
- D. Up to the discretion of individual clinics



TRIVIA

How many blood pressure readings are recommended to be taken each time BP is measured?

- A. One
- B. Two
- C. Three
- D. As many as there is time for

Case 1 – LB

- 52-yo female recently diagnosed with stage 1 hypertension – Average daily BP is 154/88mmHg
- Her primary care provider suggested that she obtain a blood pressure cuff and check her blood pressure at least once a day at home.
- She is at your pharmacy counter with a manual sphygmomanometer (with stethoscope), an automated arm cuff, and an automated wrist cuff.
- **Which cuff would you recommend?**
- **How would you counsel her to use it?**

Case 2 – AC

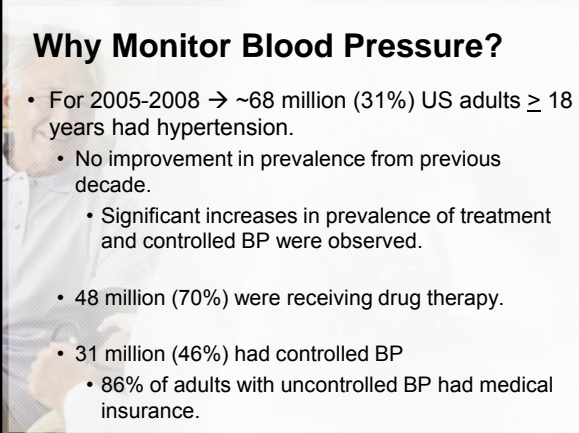
- 63-yo male with history of HTN, dyslipidemia, & GERD. BP today = 166/92mmHg – (checked on electronic home BP monitor)
- AC has come to the pharmacy today with concerns over the calibration of his home blood pressure monitor.
 - The monitor is about 5 years old.
 - He changed the batteries 1 month ago when the readings started to seem elevated and “off”.
 - No change has occurred since changing the batteries.
- **How do you respond?**

Case 3 -- JS

- 65-yo female here for 2nd visit with BP Education Program.
- PMH includes hypertension and “borderline” type 2 diabetes.
- Takes only APAP or Ibuprofen PRN and Echinacea daily.
- Drinks one cup of coffee per day, no other caffeine consumption. No tobacco or alcohol use.
- At first visit was given a BP monitor and asked to check her BP. She has been checking her BP with the monitor she received and comparing it to a monitor that she purchased 8 years ago.
- At this visit she states that her average BP with the new monitor is much lower (~138/88mmHg) than her previous monitor (~150/90mmHg) and wants to know why since she has not changed anything.
- **How would you counsel JS? What do you want to know?**

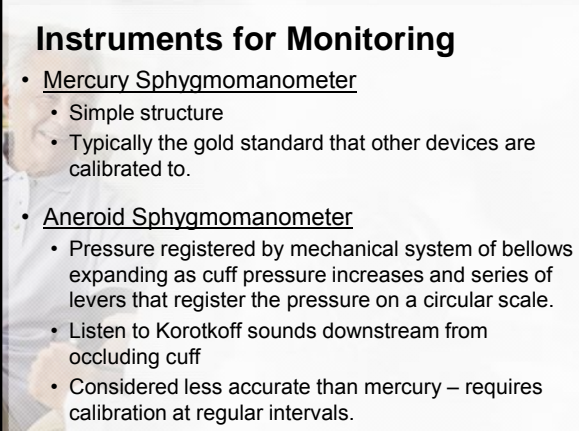


Blood Pressure Monitoring



Why Monitor Blood Pressure?

- For 2005-2008 → ~68 million (31%) US adults \geq 18 years had hypertension.
 - No improvement in prevalence from previous decade.
 - Significant increases in prevalence of treatment and controlled BP were observed.
- 48 million (70%) were receiving drug therapy.
- 31 million (46%) had controlled BP
 - 86% of adults with uncontrolled BP had medical insurance.



Instruments for Monitoring

- Mercury Sphygmomanometer
 - Simple structure
 - Typically the gold standard that other devices are calibrated to.
- Aneroid Sphygmomanometer
 - Pressure registered by mechanical system of bellows expanding as cuff pressure increases and series of levers that register the pressure on a circular scale.
 - Listen to Korotkoff sounds downstream from occluding cuff
 - Considered less accurate than mercury – requires calibration at regular intervals.

Instruments for Monitoring

- Oscillometric Devices
 - Measure the movement of blood through the artery.
 - Available for HBPM and for continuous ambulatory BP monitoring.
 - Maximal oscillation point corresponds to mean intra-arterial pressure.

Oscillometric Devices

- Oscillations are measured during gradual cuff deflation.
- Oscillations begin above SBP and continue below DBP
 - Therefore SBP & DBP can only be estimated indirectly according to an empirically derived algorithm

Oscillometric Devices

- Advantages
 - Placement of cuff is not critical.
 - Less susceptible to external noise (but not to low frequency mechanical vibration)

Oscillometric Devices

- Disadvantages
 - Amplitude of oscillation depends on several factors other than BP
 - Most important = Stiffness of Arteries
 - Elderly patients with stiff arteries & wide pulse pressures – MAP may be underestimated
 - Algorithms are different among devices & are not shared between manufacturers
 - May not be as accurate for patients with arrhythmias due to the oscillation technique

Current Hierarchy of Accuracy

1. *Auscultatory devices*
 - a) Mercury Sphygmomanometers
 - b) Aneroid Sphygmomanometers
2. *Oscillometric Devices*
 - a) Continuous ambulatory BP monitors
 - b) Home BP monitors (electronic) – *Arm Cuffs*
3. *Wrist cuffs*
4. *Finger cuffs*

The Aneroid Sphygmomanometer



Why is Technique Important?

- Overestimating BP by 5mmHg would result in 27 million people falsely labeled as hypertensive.
- Underestimating BP by 5mmHg would result in 21 million people classified as “pre-hypertensive” versus Stage 1 leading to undertreatment.

The Importance of Technique

- Adherence to technique guidelines was observed in 114 physicians
 - 96% did not allow adequate resting time
 - 62% did not palpate to maximal point of inflation
 - 97% did not use appropriately sized cuff
 - 82% did not use appropriate deflation rate
- Implication?
 - *Inaccurate BP readings!*

Recommended cuff sizes by American Heart Association (AHA) and National Heart, Lung, and Blood Institute (NHLBI)

Cuff size	Bladder width (cm)	Bladder length (cm)	Range of arm circumferences* (cm)
Newborn	4	8	Up to 10
Infant	6	12	10 to 15
Child	9	18	15 to 22
Small adult	12	22	22 to 26
Adult	16	30	26 to 34
Large adult	16	36	34 to 44
Thigh	16	42	45 to 52

*Calculated so that the largest arm would allow the bladder length to encircle at least 80 percent of the arm and the bladder width would be at least 40 percent of the largest arm's circumference

Posture & Position

- *Back not supported* –
 - DBP may be increased by ~ 6 mmHg
- *Legs crossed* –
 - SBP may be increased by ~ 2 to 8 mmHg
- *Arm Position*
 - Below heart level (e.g. below R atrium) = High readings
 - Above heart level = Low readings
 - Differences are attributed to hydrostatic pressure
 - May be 2mmHg different per inch above/below heart level

Stethoscope Controversy – Diaphragm or Bell?

- Korotkoff sounds are of low frequency
 - Argument is that the Bell of the stethoscope will enable you to hear these low frequency sounds better.
- Current JNC7 guidelines don't specify if Bell or Diaphragm should be used
 - JNC6 (1997) and WHO (1999) recommended the Bell
- American Heart Association recommends the Bell
- European Society of Hypertension guidelines (2003) recommend the diaphragm
 - Easier to hold and covers a greater area

Diaphragm or Bell?

- Study 1 – (1983) – 48 participants in US
 - Combinations of Bell—Brachial Artery (BB), Bell-Cubital fossa (BC), diaphragm-brachial artery (DB), and diaphragm-cubital fossa (DC) were applied in random order.
 - Patients were in supine position.
 - Statistically significant readings for SBP & DBP with BB combo compared to DC.
 - No significance was found between DB & BC.
 - Authors concluded that Korotkoff sounds were heard better with the bell of the stethoscope placed over brachial artery pulse versus the diaphragm over the cubital fossa.

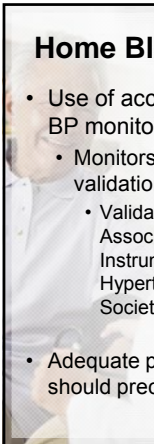
Diaphragm or Bell?

- Study 2 – (2005) – 250 participants in Turkey
 - Compared the Bell to the Diaphragm when positioned over the brachial artery using a conventional stethoscope.
 - Patients in sitting position.
 - No statistical significance was found in SBP or DBP when comparing the Bell to the Diaphragm.
- Other studies come to varying conclusions as well.
 - Studies are often in a small number of patients and occurred in the 1980s to early 1990s.



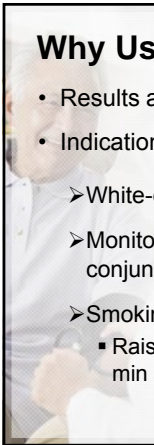
Home Blood Pressure Monitoring (HBPM)

- Recommended by several national and international guidelines, including AHA, JNC7, WHO, the British HTN Society, & the European Society of HTN.
- JNC7 recognizes HBPM as:
 - A method to assess differences between in-office and at-home BP measurements and to resolve discrepancies.
 - A method to involve patients in their own HTN management by facilitating goal setting and behavior change.



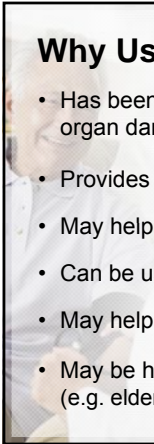
Home Blood Pressure Monitoring (HBPM)

- Use of accurate and properly validated automated BP monitors strongly encouraged.
 - Monitors must have passed 1 of 3 accepted validation protocols.
 - Validation protocols were developed by the Association for the Advancement of Medical Instruments (AAMI), the European Society of Hypertension (ESH), and the British Hypertension Society (BHS).
- Adequate patient education on use of BP monitor should precede recommendation for HBPM.



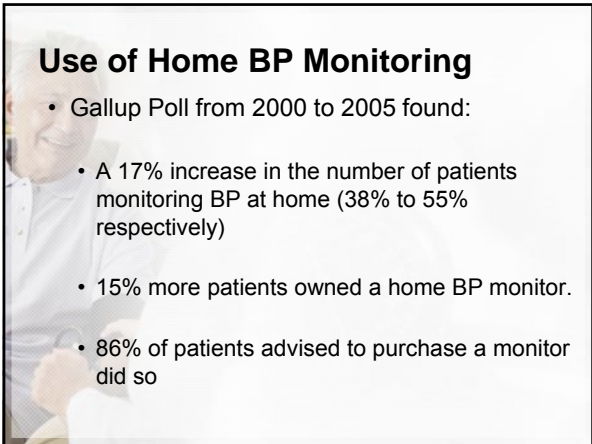
Why Use Home BP Monitoring?

- Results are often reproducible and reliable.
- Indications for HBPM:
 - White-coat HTN
 - Monitoring of effective BP management in conjunction with office BP measurement.
 - Smoking
 - Raises BP acutely, but returns to baseline 15 min after stopping.



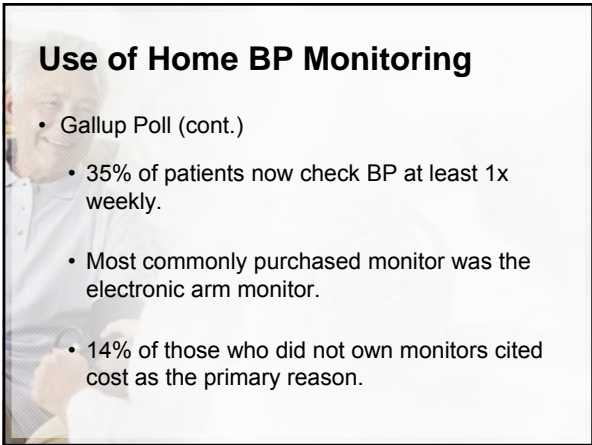
Why Use Home BP Monitoring?

- Has been shown to be useful in predicting target organ damage, CVD mortality, and CVD events.
- Provides information about BP control.
- May help guide and evaluate treatment.
- Can be used to improve medication adherence.
- May help to improve overall BP control.
- May be helpful in special populations (e.g. elderly, diabetes, pregnancy, CKD, children)



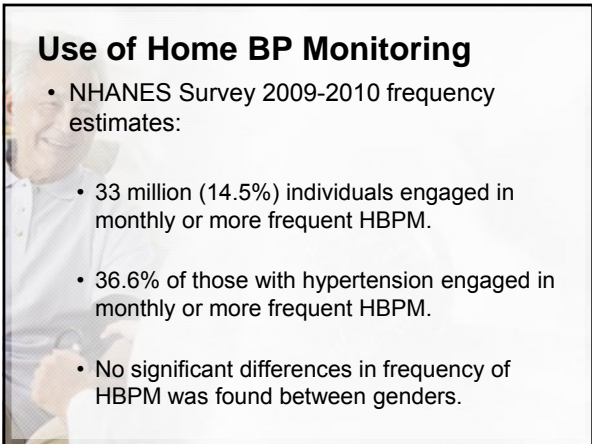
Use of Home BP Monitoring

- Gallup Poll from 2000 to 2005 found:
 - A 17% increase in the number of patients monitoring BP at home (38% to 55% respectively)
 - 15% more patients owned a home BP monitor.
 - 86% of patients advised to purchase a monitor did so



Use of Home BP Monitoring

- Gallup Poll (cont.)
 - 35% of patients now check BP at least 1x weekly.
 - Most commonly purchased monitor was the electronic arm monitor.
 - 14% of those who did not own monitors cited cost as the primary reason.



Use of Home BP Monitoring

- NHANES Survey 2009-2010 frequency estimates:
 - 33 million (14.5%) individuals engaged in monthly or more frequent HBPM.
 - 36.6% of those with hypertension engaged in monthly or more frequent HBPM.
 - No significant differences in frequency of HBPM was found between genders.

Use of Home BP Monitoring

- Factors that increased monthly and weekly HBPM included:
 - Higher age
 - ↑ BMI
 - Low family income-to-poverty ratio (FIPR)
 - # of visits to healthcare providers
 - Having health insurance
 - Being aware of, treated for, and controlled for hypertension.

Physician's Attitude Toward HBPM (DocStyles 2010 Survey)

- Internet survey completed by 1000 physicians and 254 nurse practitioners (RR 45.2% and 52.6% respectively).
- Asked 2 questions related to HBPM:
 - What % of your HTN patients do you recommend a HBPM kit?
 - When you don't recommend HBPM, what is typically the main reason?
 - Patient won't use it?
 - Patient won't use it correctly?
 - Patient can't afford it?
 - Home kits not reliable?
 - Patient doesn't need it?
 - Other reason?

DocStyles 2010 Results

- 32% of PCPs recommended HBPM to 100% of their patients.
- Rate of HBPM recommendations by the remaining 68% of PCPs:
 - 26% to ≤ 40% of their patients
 - 42% to 50-80% of their patients
 - 32% to ≥ 90% of their patients

DocStyles 2010 Results

- For those recommending HBPM to $\geq 90\%$ of their HTN patients:
 - 45% were family physicians
 - 31% were internists
 - 25% were nurse practitioners
- PCPs who worked in group practice settings were most likely to recommend HBPM as compared to individual practice or hospital-based practice.

DocStyles 2010 Results

- For PCPs who recommended HBPM $\leq 40\%$ of time, most common reasons included:
 - Patient can't afford it (43%)
 - Patient doesn't need it (36%)
 - Patient won't use.
 - Home kits are not reliable.
- PCPs who ate fruits/veggies 1-3 days/week or more were less likely to recommend HBPM.
- PCPs whose patients were classified as lower middle class to affluent were 2-3x more likely to recommend HBPM to $\geq 90\%$ of patients.

Choosing a Home Monitor



When Recommending a Home BP Monitor – Consider This....

- Measurements between arm, wrist, and finger can vary substantially.
 - Arm is considered most accurate of the 3.
- Wrist cuffs are smaller than arm cuffs and can be used in obese patients with more comfort.
 - Wrist size is not affected by obesity.
- BP kiosks at grocery stores and retail pharmacies are not often accurate – largely due to inappropriate cuff size and lack of machine calibration.

When Recommending a Home BP Monitor – Consider This....

- Size does matter!
 - Be sure to measure patient's arm to determine appropriate cuff size.
 - Cuff too small – BP higher
 - Cuff too large – BP lower
- Cost
- Dexterity
 - Most patients will not be able to use a manual sphygmomanometer with stethoscope due to lack of dexterity and inability to hear Korotkoff sounds.

Arm Circumference & Cuff Size: NHANES Review 2013

- Trends in mid-arm circumference and cuff size distribution were evaluated using NHANES data from 1999-2002, 2003-2006, & 2007-2010.
 - 28,233 participants \geq 20 years were evaluated.

	Mean Mid-Arm Circumference			
	1999-2002	2003-2006	2007-2010	p-value
Men	33.9cm	34.1cm	34.2cm	< 0.05
Women	32cm	31.9cm	31.9cm	> 0.05

**Arm Circumference & Cuff Size:
NHANES Review 2013**

- To have the appropriate cuff size it was found that:
 - 42.9% of men and 25.3% of women needed large cuffs
 - 1.9% of men and 2.8% of women needed thigh cuffs
- Groups that required BP cuffs with sizes different (typically larger) than the standard adult BP cuff for accurate measurement included:
 - Hypertension → 52% men; 38% women
 - Diabetes → 59.1% men; 53.6% women

**When Recommending a Home BP Monitor
– Consider This....**

- Websites that list validated machines:
 - DABL Educational Trust www.dableducational.org.
 - Hypertension Canada
 - <http://hypertension.ca/chs/devicesendorsements/devices-endorsed-by-chs/>
 - British HTN Society www.bhsoc.org
- *Blood Pressure Monitoring* is a journal that often provides short articles discussing the validation and calibration of a variety of different automated monitors – including generic brands.

Validation and Accuracy

- Using a Validated home BP monitor is highly recommended & should be calibrated every 1 to 2 years.
- Check patient's technique frequently to ensure that the device is being used correctly for accurate measurement.

Checking the Accuracy of HBPMs

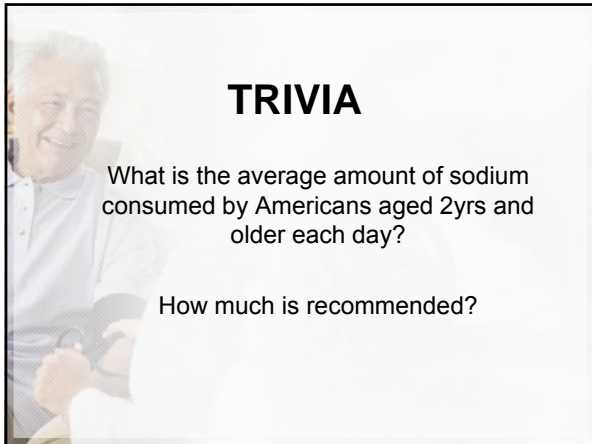
- Have patient sit with monitor set up & arm at heart level.
- Take 5 sequential same-arm BP readings at a gap of no more than 30 seconds between readings.
 - 1st and 2nd readings taken with patient's device
 - 3rd by provider with mercury sphygmomanometer
 - 4th by patient's device
 - 5th by provider.
- Accuracy of device can be assessed by comparing patient's device and mercury readings.
- Adapted from European Society of HTN Protocol

Factors that Affect BP Readings

- Temperature
- Exercise
- Alcohol
- Caffeine
- Nicotine
- Arm position
- Muscle tension
- Bladder distension
- Talking
- Background noise
- Posture

Additional Resources

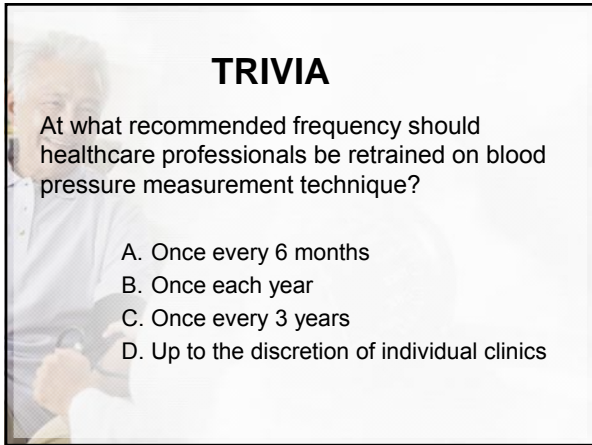
- *New England Journal of Medicine*
 - Videos in Clinical Medicine – Blood Pressure Measurement
 - www.nejm.org/multimedia/medical-videos
 - Must be NEJM subscriber to access
- *American Society of Hypertension*
 - www.ash-us.org
- *National Heart, Lung, and Blood Institute*
 - www.nhlbi.nih.gov
- *Hypertension Canada*
 - <http://hypertension.ca/chep>
- *Michigan's High Blood Pressure University*
 - www.michigan.gov/hbpu (click on 'professional campus')



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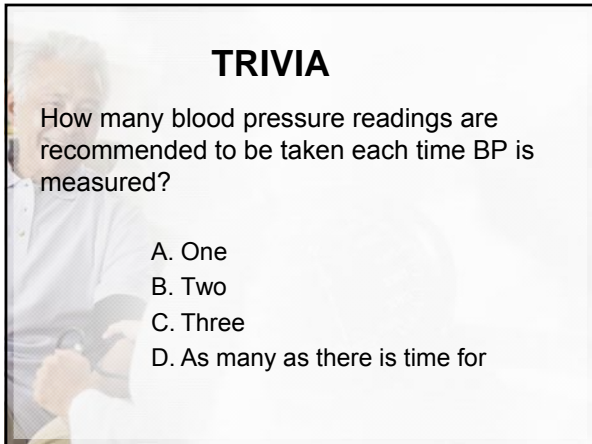
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Case 1 – LB

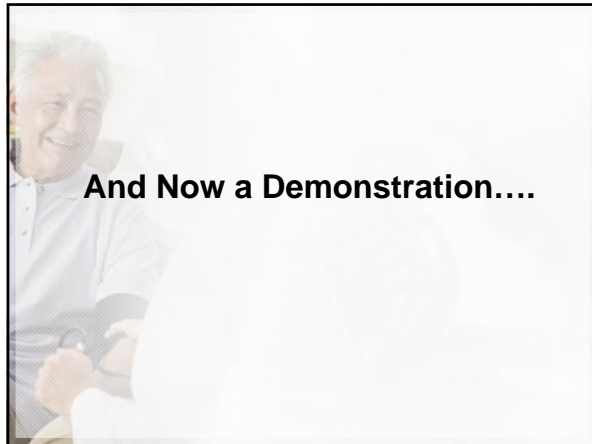
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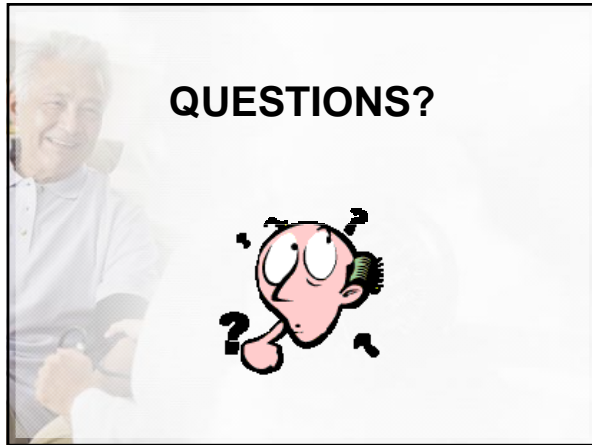
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